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(54) **Method for transporting liquid in a dishwasher and a device for accomplishing the method.**

(57) This invention relates to a method and a device for transporting liquid in a dishwasher (19) from a liquid reservoir (22) to the dish which is placed in a tub in the machine. The liquid is conpulsory transferred to a liquid fog which condenses on said dish. Preferably the fog is generated by ultrasonic means (20).

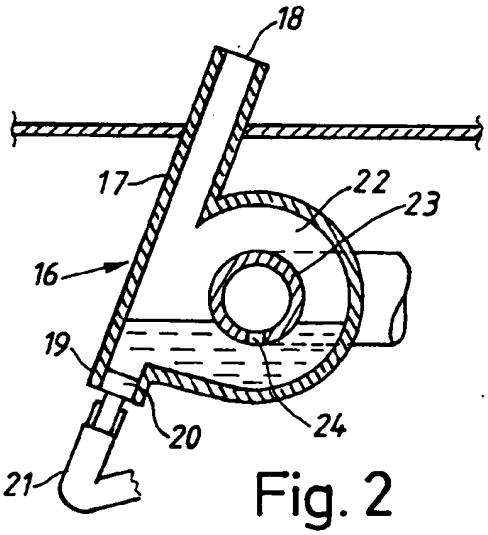


Fig. 2

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This invention relates to a method and a device for transporting liquid in a dishwasher from a liquid reservoir to the dish which is placed in a tub in the machine.

In conventional dishwashers water is taken into a tub in which the dish is placed after which the water might be mixed with detergents and is circulated through nozzles which are directed towards the dish and which are placed on rotating spray arms in the tub. The water is collected in a receptacle at the bottom of the tub which receptacle communicates with a circulation pump and the water is after each wash - or rinse cycle transferred to the sewage by means of a drain pump. During the washing process fresh water enters into the tub each time a new wash or rinse cycle is started which means that the water consumption for modern machines is about 20 - 25 liters separated into 5 liters for each cycle. The dirt on the dish is dissolved and removed by means of the circulating liquid flow and also by the spray pressure of the jets.

Although the total water consumption for dishwashers has been reduced considerably during the last years to the quantities mentioned above, the fact remains that the water consumption with respect to the size of the areas of the dish lies on a rather high level which means a large energy consumption for heating the water to a suitable washing temperature and also high consumption of chemicals in order to achieve the necessary cleaning effect. At conventional machines there also is a problem in limiting the noise to acceptable levels.

It has been suggested, see EP 291 713, to suppy steam to the tub in a pre-treatment procedure of the washing process in order to dissolve the dirt on the dish and facilitate the further cleaning process. The drawback with such a method is the high demand for energy supply in order to vaporize the water and there also is a risk that steam blows out from the machine which can cause injuries.

It is also previously known, see Patent Abstract of Japan 59-55367, to coat surfaces in a treatment chambers with an antistatic agent by first atomizing the agent by means of ultrasound and then desposiing the agent on the surfaces. This method has however solely been used for covering a surface with a thin coating.

The purpose of this invention is to eliminate the abovementioned drawbacks and to create a new washing method and a device working with very small quantities of water and/or detergents and with very low energy consumption, the process being mainly silent. This is achieved by means of a method and a device having the characteristics mentioned in the claims. The method can sometimes be used as a complete washing process but is preferably used as a part of a conventional dishwashing process, for instance as an introductory step to the process or as a method for dosing detergents in particular biologically active substances on the dish.

An embodiment of a dishwasher in which the method according to the invention is used will be described more in detail below with reference the accompanying diagrammatic drawings on which Fig. 1 is a perspective view of a first embodiment of a dishwasher provided with a device according to the invention wheras Fig. 2 is a section on the line II-II in Fig. 3, Fig. 3 is a side view of the device according to Fig. 2 and Fig. 4 is a diagrammatic section of a second embodiment of a dishwasher according to the invention.

The method according to the invention means that transportation of liquid in a tub is achieved by creating a liquid fog which is spred to the dish and is condensed on it thereby dissolving and rinsing the dirt from the dish. The liquid fog is preferably generated by ultrasonic means from a liquid consisting, for instance, of chemicals and/or water, the chemicals being suitable for dissolving dirt during the cleaning process. The chemicals preferably comprise tensides, enzyms, other proteins and/or other bioactive substances.

The liquid drops in the fog created can be regarded as "cold" - which is important for biologically active substances in order to maintain their activity- since the liquid is never heated to the boiling point which is the case when vaporizing. In order to create a large amount of fog by means of a small effect a piezo-ceramic available on the market is placed below the liquid surface. When activating the piezo-ceramic which is made by connecting voltage to it ultra-sound is generated which creates fog drops which, compared to steam drops, have a uniform diameter. The size of the fog drops can be predetermined since there is an unambiguous, inversely proportional relationship between the average diameter of the drops and the frequency of the ultra-sound. It is important to choose an accurate size of the droplet in order to bring the detergents with the fog. A suitable drop diameter is within the interval 0.5 - 25 micron. It is, of course, possible to generate the fog also in other ways, for instance, with conventional aerosol methods.

Because the substances in the liquid in certain cases, for instance with regard to proteins and enzyms, can denaturate at high temperatures, i.e. in the interval 40 - 100°C, it is important that the fog is so cold that the substances still are active when the fog condenses on the dish. Since the efficiency of said fog creator increases with increased liquid temperature it is, however, desireable to use an as warm liquid as possible during the generation of fog. The fog creation can be rendered even more effective if a suitable flow pattern is achieved in the liquid around and above the ultra-sound transmitter. Thus, the fog creator can be provided with a pump in order to achieve a suitable auxiliary flow. If the space around the transmitter is shaped as a pipe or a nozzle, the liquid can be pum-

ped so fast that a jet flows out from the device. This flow can thus be directed towards the dish thereby removing the dirt on it. Such a pipe or nozzle has at the same time a focusing influence on the ultrasonic field, which means an increased efficiency of the fog generator. Since the fog drops created are electrically loaded, an electrostatic field which is placed in the fog can be arranged to direct the drops to the dish which further increases the efficiency of the method.

In Fig. 1 a dishwasher 10 is shown having an open door 11 normally covering an opening through which the dish 12 can be inserted on baskets 13 into a tub 14. In the tub 14 liquid is as usual sprayed on the dish 12 by means of rotating washarms 15. The dishwasher is provided with a fog generator 16 having a standing pipe 17, the upper end 18 of which is open and the lower end 19 of which has a piezo-ceramic 20 to which voltage can be transferred by means of a cable 21. The pipe 17 communicates with an annular chamber 22 which surrounds a liquid supply pipe 23 and which together with the lower part of the pipe 17 forms a reservoir for the liquid which preferably comprises water and a detergent. The liquid is in a matter not shown filled through the pipe 23 and flows through a hole 24 into the chamber 22. When the piezo-ceramic 20 is activated, ultra-sound is created which breaks down the liquid and forms a water fountain above the liquid surface, fog being created at the upper part of the water fountain. The fog leaves through the upper end 18 to the tub in which the dish is placed. A part of the fountain is deflected through the chamber 22 and forms a circulating liquid flow in the receptacle which further increases the efficiency of the fog creator. The fog is then condensed on the dish in the tub, the detergent thereby dissolving the dirt which then flows down from the dish.

According to the second embodiment of the invention shown in Fig. 4 the dish 12 is as usual placed on a basket 13 in the tub 14. Water is taken into a container 25 from an inlet pipe 26 via a valve 27 which is operated by a control unit in the machine. The container 25 is placed between the tub 14 and a hood 28 surrounding the machine and has at its bottom a piezo-ceramic 20 which via an electric conductor 29 is connected to equipment 30 supplying the piezo-ceramic with voltage.

The container 25 and the tub 14 are provided with an opening 31 through which liquid and fog can flow from the container into the tub. This opening serves as an overflow device for the liquid entering the container and maintains a constant distance between the liquid surface in the container and the piezo-ceramic thereby creting a maximum amount of fog.

The machine is also provided with a receptacle 32 for a detergent, preferably a biologically active substance, which is filled through a refill opening 33 into the receptacle. At the bottom of the receptacle there is an outlet pipe 34 through which the detergent flows to a dispenser cylinder 35 from which the detergent is transferred via a pipe 36 to the container 25 where it is mixed with the water in the container. When the piezo-ceramic is activated fog is created in the container and this fog flows through the opening 31 into the tub 14 where it covers the dish which is then cleaned by the detergent-water mixture.

It should be mentioned that the amount of biologically active substances needed for a dishwash operation according to the invention is very low and is less than 5 g.

## Claims

1. Method for transporting liquid in a dishwasher from a liquid reservoir to the dish which is placed in a tub in the machine, **characterized** in that a liquid is compulsorily transferred to a liquid fog which is condensed on said dish.

2. Method according to claim 1, **characterized** in that the liquid comprises active substances preferably biologically active substances.

3. Method according to claim 1 or 2, **characterized** in that the fog is generated by ultra-sound.

4. Method according to any of the preceding claims **characterized** in that the liquid is heated before the fog is generated so that the temperature of the fog is somewhat higher than the temperature of the surfaces of the dish.

5. Dishwasher for accomplishing the method in claim 1 comprising a tub (14) in which the dish (12) is placed, **characterized** in that the dishwasher is provided with a device (16) by means of which fog is created and transported to the surface of the dish (12).

6. Dishwasher according to claim 5, **characterized** in that the fog-creating device (16) comprises a liquid reservoir (22, 25) in which an ultrasonic source (20) is placed.

7. Dishwasher according to claim 6, **characterized** in that the ultrasonic source (20) is a piezo-ceramic.

8. Dishwasher according to claim 6, **characterized** in that the liquid reservoir (22) comprises an annular shaped chamber to which a pipe (17) which is open at one end (18) is mainly tangentially arranged the other end of the pipe being provided with the ultrasonic source (20).

9. Dishwasher according to claim 7, **characterized**

in that the liquid reservoir (25) is provided with a device, preferably an overflow device, for maintaining a mainly constant distance between the piezo-ceramic (20) and the liquid surface in the reservoir (25).

10. Dishwasher according to any of claims 5-9, **characterized** in that it is provided with a receptacle (32) for a detergent which receptacle is connected to the reservoir (25) via a dosing arrangement (35).

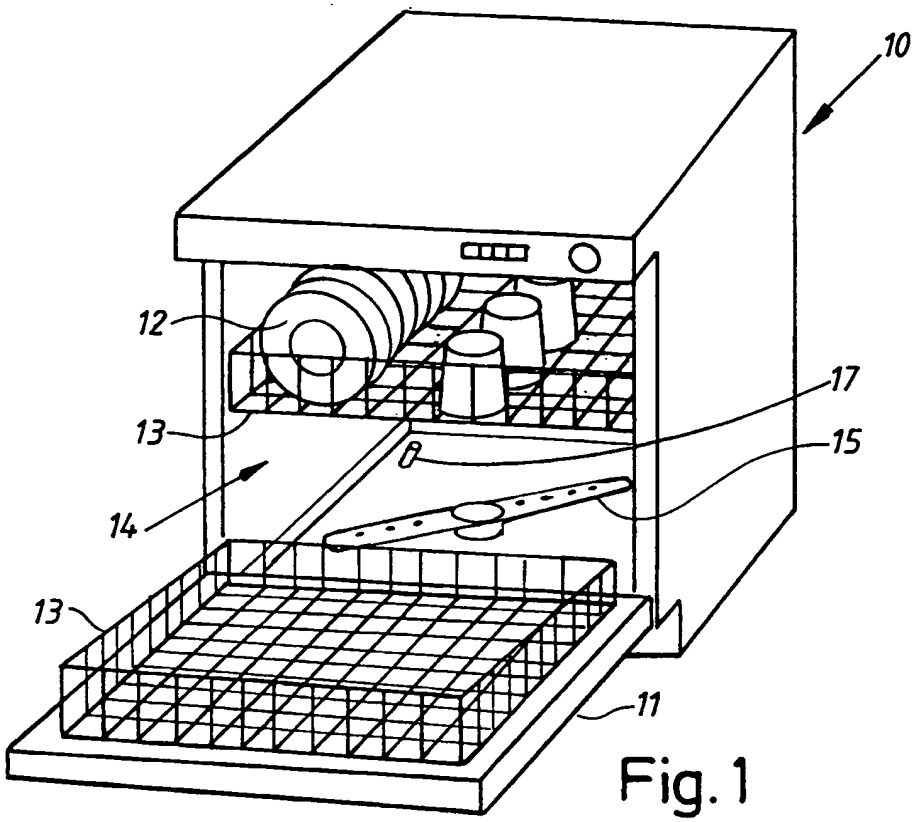


Fig. 1

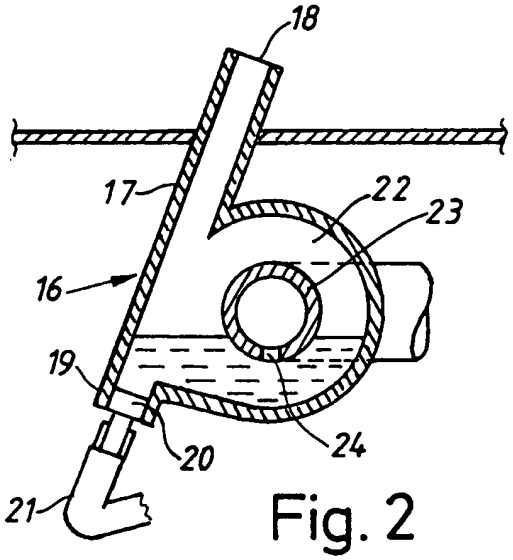


Fig. 2

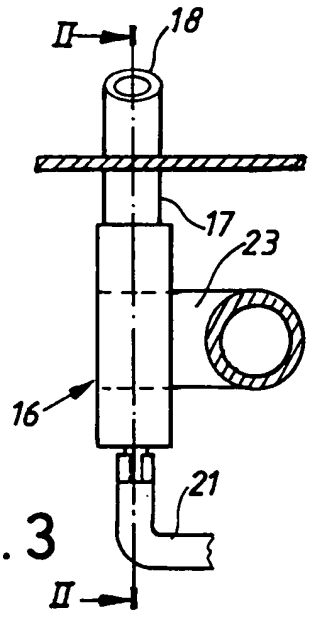


Fig. 3

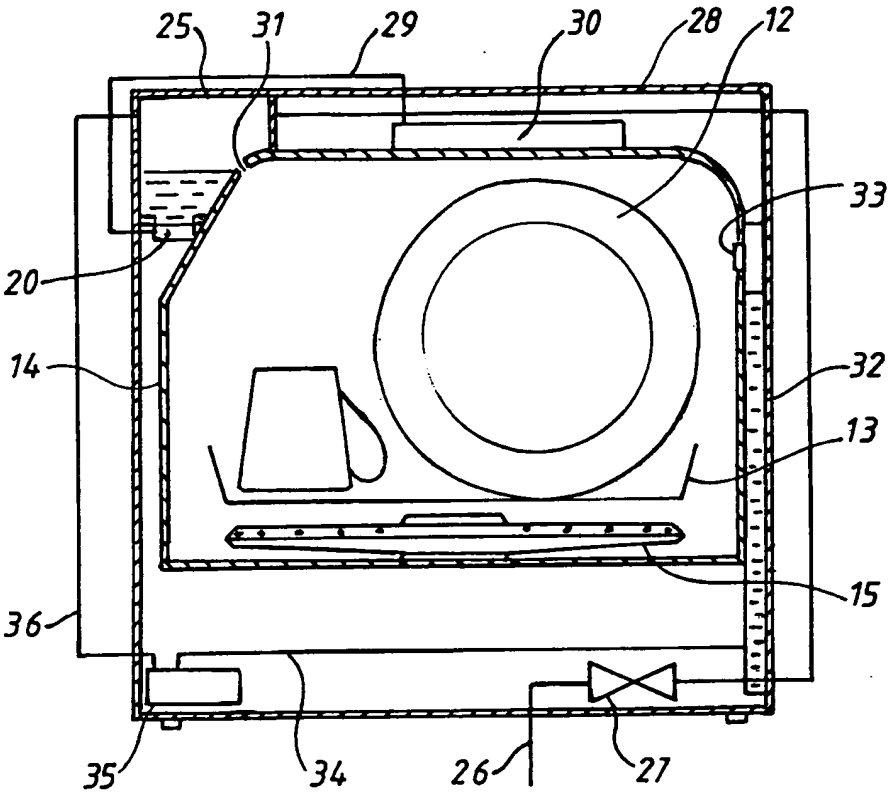


Fig. 4

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# EUROPEAN SEARCH REPORT

Application Number

EP 91 85 0279

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
|---|---|---|---|
| X | US-A-2 664 094 (J.H. SPRAGINS)<br>* the whole document * | 1,5 | A47L15/00<br>A47L15/13 |
| A | FR-A-1 506 582 (R. GROEBLI)<br>* the whole document * | 1 | |
| X | US-A-2 910 391 (H.A.TOULMIN) | 5 | |
| A | * the whole document * | 1 | |
| A | WO-A-9 006 817 (GRÜNBECK WASSERAUFBEREITUNG)<br>* claims 1-13 * | 3,6-9 | |
| D,A | PATENT ABSTRACTS OF JAPAN<br>vol. 8, no. 150 (C-233)12 July 1984<br>& JP-A-59 055 367 ( TOK KK ) 30 March 1984<br>* abstract * | 1 | |
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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 12 FEBRUARY 1992 | KELLNER M. |

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